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COMPARATIVE TOLERANCES OF LODGEPOLE PINE
AND THIN-LEAVED HUCKLEBERRY
TO BORON AND MANGANESE

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ABSTRACT

Lodgepole pine and thin-leaved huckleberry seedlings were treated with several levels of boron and manganese in the greenhouse. Huckleberry was less tolerant of excess boron than was lodgepole pine. Both species tolerated excess manganese. Further testing of these micronutrients to favor huckleberry and eliminate lodgepole pine is not recommended.

KEYWORDS: Lodgepole pine, thin-leaved huckleberry, micronutrients(-growth, herbicide side effects.

REST SERVICE - U.S. DEPARTMENT OF AGRICULTURE - PORTLAND, OREGON

INTRODUCTION

Lodgepole pine (*Pinus contorta*) is one of the most important invading species in the dwindling mountain huckleberry fields of Oregon and Washington. Thin-leaved huckleberry (*Vaccinium membranaceum*) is the most important berry species. Several experiments are underway at the Pacific Northwest Forest and Range Experiment Station to determine the most efficient methods of controlling the lodgepole pine and other invaders without damaging thin-leaved huckleberry. Conventional herbicides have not been successful in thin-leaved huckleberry fields. However, several authors (Smith et al. 1947, Medappa and Dana 1970, Gambi et al. 1971) either refer to tolerances of boron and manganese in other *Vaccinium* species or report high concentrations of manganese in these species.

The study reported here was undertaken to determine the relative tolerances of lodgepole pine and thin-leaved huckleberry to several levels of boron and manganese applied in a greenhouse environment. It is a preliminary test in which I hoped to find concentrations of these micronutrients that would favor huckleberry and eliminate lodgepole pine.

METHODS

Huckleberry and lodgepole pine plants were grown from seed in a growth chamber. When they were 4 months old, they were chilled for 3 months, then grown on greenhouse benches in a peat-sand soil (50 percent peat, 50 percent sand) fertilized periodically with ammonium sulfate, a dilute macronutrient solution,[1/] and small amounts of fritted trace elements. A randomized-blocks experimental design was used, with one seedling per treatment in each block. The total height of each seedling was measured and recorded 1 month after the end of the chilling period. Micronutrient treatments then were applied to each species, in each of the four greenhouse blocks:

Control (no boron, no manganese)
B1 (10 p/m boron)
B2 (100 p/m boron)
B3 (500 p/m boron)
B4 (1,000 p/m boron)
M1 (20 p/m manganese)
M2 (200 p/m manganese)
M3 (1,000 p/m manganese)
M4 (2,000 p/m manganese)

B1 + M1
B1 + M2
B1 + M3
B1 + M4
B2 + M1
B2 + M2
B2 + M3
B2 + M4

B3 + M1
B3 + M2
B3 + M3
B3 + M4
B4 + M1
B4 + M2
B4 + M3
B4 + M4

Borax and manganese sulfate were used to obtain the required B and Mn concentrations. For each micronutrient treatment, 50 ml of solution were applied to each seedling. Micronutrient treatments were randomly located in each block. The initial treatment with the same solution concentrations and volumes was repeated 2 weeks later.

Total heights were remeasured 4 months after the initial micronutrient treatment. All plants then were harvested, ovendried at 65° C for 48 hours, and weighed. Survival, height growth, and weight data were all subjected to analyses of variance.

[1/] 1.6 g $Ca(NO_3)_2$, 1.0 g KNO_3, 0.5 g $MgSO_4$, and 0.3 g KH_2PO_4 per liter H_2O.

RESULTS AND CONCLUSIONS

Toxicity symptoms were more severe on huckleberry than on lodgepole throughout the 4-month growth period. All huckleberries treated with both 1,000 p/m B and 0 p/m Mn died (table 1), and lower boron concentrations caused leaf mottling and spotting. However, the huckleberries treated with high concentrations of both manganese and boron seemed less affected than those treated with high concentrations of boron alone. Needle browning was common on all of the lodgepole pines, but none died, and the only treatment-associated toxicity symptom observed was blue-green foliage and shorter needles on many of the treated trees.

Table 1.--*Huckleberry survival, by nutrient treatment*

Manganese concentration (p/m)	Boron concentration (p/m)					Average survival, all boron treatments
	0	10	100	500	1,000	
				Percent		
0	100	100	100	100	0	80
20	75	100	100	50	50	75
200	75	75	100	100	75	85
1,000	100	100	100	50	75	85
2,000	75	100	100	50	100	85
Average survival, all manganese treatments	85	95	100	70	60	

The lodgepole pines were heavier than the huckleberries (table 2). Boron concentrations of more than 100 p/m significantly reduced the final weights of both huckleberry and lodgepole pine. Boron also reduced height growth of both species (table 3). Except for their interaction with boron on huckleberry survival, the manganese treatments had no statistically significant influence on either huckleberry or lodgepole pine.

Although no significant species X micronutrient interactions are evident in the weight- and height-growth information presented here, the survival data indicate that thin-leaved huckleberry is less tolerant of high boron concentrations than is lodgepole pine. Any use of large quantities of boron in the mountain huckleberry fields probably would be counterproductive--huckleberries would be killed before the invading lodgepole pines. Both species seem to be manganese-tolerant. Further testing of either micronutrient as a selective vegetation-control agent is not recommended.

Table 2.--*Average ovendry weights of huckleberry* (H) *and lodgepole pine* (LP), *by nutrient treatment*[1/]

Manganese concentration (p/m) and species		Boron concentration (p/m) and species										Average, H	Average, LP	Average, both species
		0		10		100		500		1,000				
		H	LP	H	LP	H	LP	H	LP	H	LP			
								Grams						
0	H	1.375		0.987		0.865		0.622		0.180		0.806		
	LP		4.082		4.103		3.572		2.362		3.163		3.456	2.131
20	H	1.162		1.340		1.229		.548		.360		.928		
	LP		3.935		3.480		4.000		3.325		2.280		3.404	2.166
200	H	1.053		1.825		.470		.533		.583		.893		
	LP		3.273		4.145		3.838		2.763		3.512		3.506	2.200
1,000	H	1.070		.950		2.124		.358		.715		1.043		
	LP		2.728		4.083		3.233		3.985		2.815		3.369	2.206
2,000	H	.923		1.586		1.696		.342		.596		1.029		
	LP		4.355		4.172		4.678		2.565		2.928		3.740	2.384
Average, H		1.117		1.338		1.277		.481		.487		.940		
Average, LP			3.675		3.997		3.864		3.000		2.940		3.495	
Average, both species		2.396		2.667		2.570		1.740		1.713				

[1/] Species differences and the differences among boron treatments are statistically significant at the 0.01 level. The differences among manganese treatments are not statistically significant, and there are no significant interactions.

Table 3.--*Average height growth of huckleberry* (H) *and lodgepole pine* (LP), *by nutrient treatment*[1/]

Manganese concentration (p/m) and species		Boron concentration (p/m) and species										Average, H	Average, LP	Average, both species
		0		10		100		500		1,000				
		H	LP	H	LP	H	LP	H	LP	H	LP			
								Centimeters						
0	H	4.52		0.12		2.72		0.12		0		1.50		
	LP		3.02		1.88		1.58		1.92		0.65		1.81	1.65
20	H	1.02		2.15		.70		.42		.02		.86		
	LP		1.60		2.55		1.75		1.42		.88		1.64	1.25
200	H	1.92		4.88		1.05		1.60		.02		1.89		
	LP		1.98		2.95		1.60		2.20		3.12		2.37	2.13
1,000	H	3.12		2.95		6.95		.05		0		2.61		
	LP		2.78		1.60		2.15		3.25		1.95		2.35	2.48
2,000	H	0		4.40		.70		0		.02		1.02		
	LP		1.08		1.92		2.92		1.88		2.12		1.98	1.50
Average, H		2.12		2.90		2.42		.44		.01		1.58		
Average, LP			2.09		2.18		2.00		2.13		1.74		2.03	
Average, both species		2.10		2.54		2.21		1.29		.88				

[1/] Differences among boron treatments are significant at the 0.05 level. Manganese differences, species differences, and the manganese x boron interaction are all nonsignificant.

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